



Radioaktivni i stabilni izotopi

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<div></div> <div></div>						18Na 1.3E-21 s ε P	19Na <40 NS P	20Na 447.9 MS ε: 100.00% εα: 20.05%	21Na 22.49 s ε: 100.00%	22Na 2.6027 Y ε: 100.00%							
						16Ne 122 KeV P: 100.00%	17Ne 109.2 MS ε: 100.00% εβ±: 100.00%	18Ne 1672 MS ε: 100.00%	19Ne 17.22 s ε: 100.00%	20Ne STABLE 90.48%	21Ne STABLE 0.27%						
						14F P	15F 1.0 MeV P: 100.00%	16F 40 KeV P: 100.00%	17F 64.49 s ε: 100.00%	18F 1.8291 H ε: 100.00%	19F STABLE 100%	20F 11.07 s β-: 100.00%					
						12O 0.40 MeV P	13O 8.58 MS εβ±: 100.00% ε: 100.00%	14O 70.606 s ε: 100.00%	15O 122.24 s ε: 100.00%	16O STABLE 99.762%	17O STABLE 0.038%	18O STABLE 0.200%	19O 26.88 s β-: 100.00%				
						10N P: 100.00%	11N 1.58 MeV P: 100.00%	12N 11.000 MS ε: 100.00%	13N 9.965 M ε: 100.00%	14N STABLE 99.634%	15N STABLE 0.366%	16N 7.13 s β-: 100.00% β-α: 1.2E-3%	17N 4.173 s β-: 100.00% β-n: 95.1%	18N 624 MS β-: 100.00% β-n: 14.30%			
						8C 230 KeV P: 100.00% α	9C 126.5 MS ε: 100.00% εβ: 61.60%	10C 19.290 s ε: 100.00%	11C 20.334 M ε: 100.00%	12C STABLE 98.89%	13C STABLE 1.11%	14C 5700 Y β-: 100.00%	15C 2.449 s β-: 100.00%	16C 0.747 s β-: 100.00% β-n: 99.00%	17C 193 MS β-: 100.00% β-n: 32.00%		
						6B 2P	7B 1.4 MeV α P	8B 770 MS εα: 100.00% ε: 100.00%	9B 0.54 KeV 2α: 100.00% P: 100.00%	10B STABLE 19.8%	11B STABLE 80.2%	12B 20.20 MS β-: 100.00% ββ: 1.58%	13B 17.33 MS β-: 100.00%	14B 12.5 MS β-: 100.00% β-n: 6.04%	15B 9.93 MS β-: 100.00% β-n: 93.60%	16B <190 PS N	
						5Be P	6Be 92 KeV α: 100.00% P: 100.00%	7Be 53.22 D ε: 100.00%	8Be 5.57 eV α: 100.00%	9Be STABLE 100%	10Be 1.51E+6 Y β-: 100.00%	11Be 13.81 s β-: 100.00% β-α: 3.1%	12Be 21.49 MS β-: 100.00% β-n: 1.00%	13Be 2.7E-21 s N	14Be 4.84 MS β-: 100.00% β-n: 94.00%	15Be <200 NS N	
3Li P						4Li 6.03 MeV P: 100.00%	5Li ≈ 1.5 MeV P: 100.00% α: 100.00%	6Li STABLE 7.59%	7Li STABLE 92.41%	8Li 839.9 MS β-α: 100.00% β-: 100.00%	9Li 178.3 MS β-: 100.00% β-n: 50.80%	10Li N: 100.00%	11Li 8.59 MS β-: 100.00% β-n: 0.027%	12Li <10 NS N			
						3He STABLE 0.000137%	4He STABLE 99.999863%	5He 0.60 MeV N: 100.00% α: 100.00%	6He 806.7 MS β-: 100.00%	7He 150 KeV N	8He 119.1 MS β-: 100.00% β-n: 16.00%	9He N: 100.00%	10He 300 KeV N: 100.00%				
1H STABLE 99.985%						2H STABLE 0.015%	3H 12.32 Y β-: 100.00%	4H 4.6 MeV N: 100.00%	5H 5.7 MeV N: 100.00%	6H 1.6 MeV N: 100.00%	7H 29E-23 Y 2N?						
						Neutron 10.23 M β-: 100.00%											

Svijet sadrži atome samo stotinjak elemenata...

SKUPINA

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IA

PERIODA

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1

1.0079

H

VODIK

2

IIA

3

6.941

Li

LITIJ

4

9.0122

Be

BERILIJ

2

11

22.990

Na

NATRIJ

12

24.305

Mg

MAGNEZIJ

3

IIIB

4

IVB

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VB

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19

39.098

K

KALIJ

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40.078

Ca

KALCIJ

21

44.956

Sc

SKANDIJ

22

47.867

Ti

TITANIJ

23

50.942

V

VANADIJ

24

51.996

Cr

KROM

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54.938

Mn

MANGAN

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55.845

Fe

ŽELJEZO

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58.933

Co

KOBALT

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58.938

Ni

NIKAL

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63.546

Cu

BAKAR

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65.39

Zn

CINK

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69.723

Ga

GALIJ

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72.64

Ge

GERMANIJ

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74.922

As

ARSEN

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78.96

Se

SELENIJ

35

79.904

Br

BROM

36

83.80

Kr

KRIPTON

37

85.468

Rb

RUBIDIJ

38

87.62

Sr

STRONCIJ

39

88.906

Y

ITRIJ

40

91.224

Zr

CIRKONIJ

41

92.906

Nb

NIOBIJ

42

95.94

Mo

MOLIBDEN

43

(98)

Tc

TEHNECIJ

44

101.07

Ru

RUTENIJ

45

102.91

Rh

RODIJ

46

106.42

Pd

PALADIJ

47

107.87

Ag

SREBRO

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112.41

Cd

KADMIJ

49

114.82

In

INDIJ

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118.71

Sn

KOSITAR

51

121.76

Sb

ANTIMON

52

127.60

Te

TELURIJ

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126.90

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JOD

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131.29

Xe

KSENON

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132.91

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CEZIJ

56

137.33

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BARIJ

57-71

La-Lu

Lantanoidi

72

178.49

Hf

HAFNIJ

73

180.95

Ta

TANTAL

74

183.84

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VOLFRAM

75

186.21

Re

RENIJ

76

190.23

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OSMIJ

77

192.22

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IRIDIJ

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195.08

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PLATINA

79

196.97

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ZLATO

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200.59

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ŽIVA

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204.38

Tl

TALIJ

82

207.2

Pb

OLOVO

83

208.98

Bi

BISMUT

84

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POLONIJ

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ASTAT

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RADON

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Fr

FRANCIJ

88

(226)

Ra

RADIJ

89-103

Ac-Lr

Aktinoidi

104

(261)

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RUTHERFORDIJ

105

(262)

Db

DUBNIJ

106

(268)

Sg

SEABORGIJ

107

(264)

Bh

BOHRIJ

108

(277)

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HASSIJ

109

(268)

Mt

MEITNERIJ

110

(281)

Ds

DARMŠTADT

111

(272)

Uuu

UNUNIJ

112

(285)

Uub

UNUNBIJ

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(289)

Uuq

UNUNKVADIJ

18

VIIIA

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HELIJ

OZNAČAVANJE SKUPINE IUPAC PREPORUKA (1985.)

OZNAČAVANJE SKUPINE CHEMICAL ABSTRACT SERVICE (1986.)

ATOMSKI BROJ

RELATIVNA ATOMSKA MASA (2)

SIMBOL

NAZIV ELEMENATA (1)

13

IIIA

5

10.811

B

BOR

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26.982

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ALUMINIJ

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28.086

Si

SILICIJ

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30.974

P

FOSFOR

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32.065

S

SUMPOR

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35.453

Cl

KLOR

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39.948

Ar

ARGON

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12.011

C

UGLJIK

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14.007

N

DUŠIK

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15.999

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KISIK

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IIIA

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VIIIA

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IIIB

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Elementi, izotopi

Kako su nastali?

Kako se ponašaju
radioaktivni
izotopi?

Zašto smo
okruženi
uglavnom
stabilnim
izotopima?

Za što se sve
koriste različiti
izotopi?

Koncept raspada na manje apstraktnom primjeru... kuhinja



Nakon stotinjak godina ostali su stol i zidovi...



Ponedjeljak, 21.3.2016. - Milivoj Uroić,
Radlonica IRB

Nakon 2000 godina
ostaje samo kamen...



...na temelju nađenih objekata možemo odrediti (procijeniti) starost

...pri tom moramo poznavati vijek trajanja objekata koje nalazimo

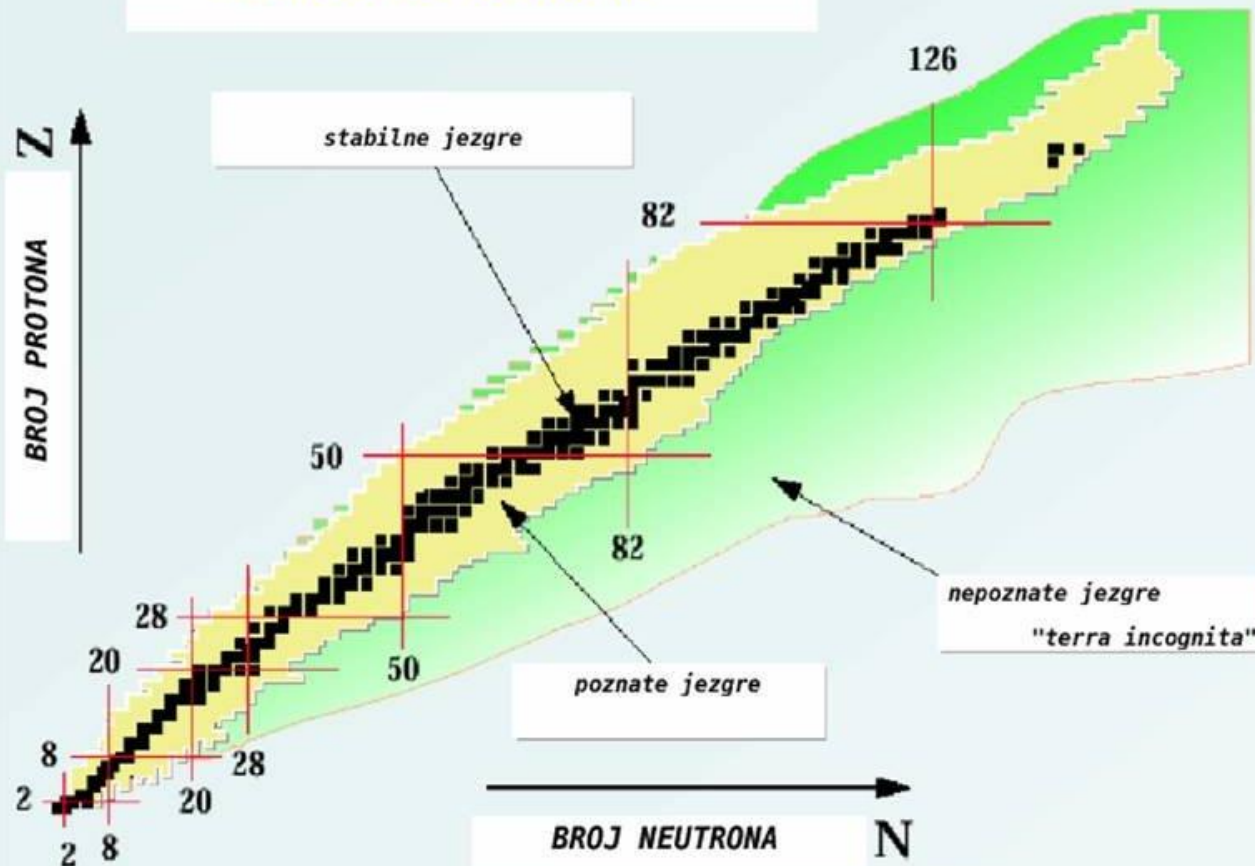
Radioizotopi kemijskih elemenata su IDEALNI mjerači vremena, imaju vijek trajanja i matematički predvidljiv vremenski tijek raspada...

Pogledajmo поблиže elemente i izotope:

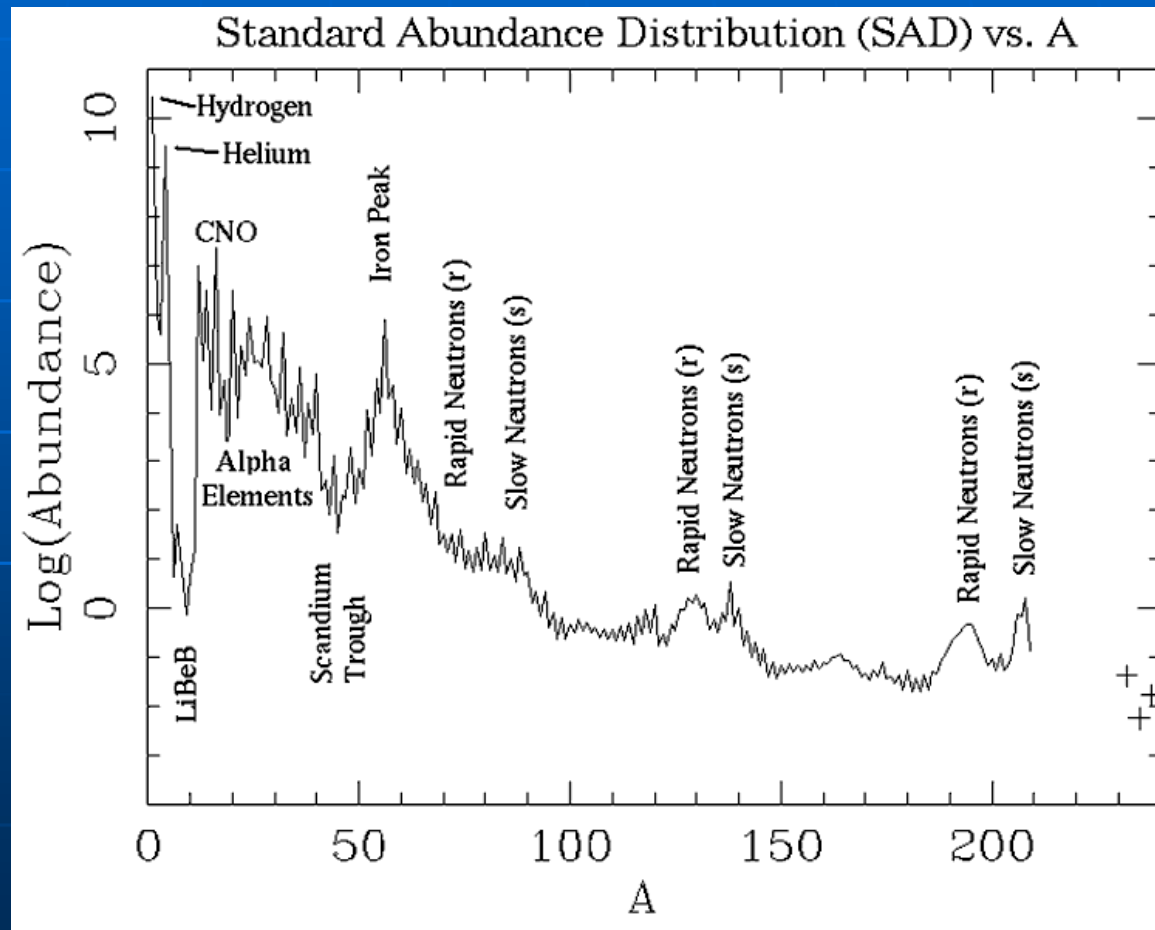
81 element ima ukupno 263 stabilna izotopa.
Ostali su RADIOAKTIVNI i imaju vrijeme
(polu)raspada.

[wikipedija](https://hr.wikipedia.org/wiki/Popis_nukleida)

ZEMLJOVID JEZGARA



Zastupljenost težina atoma (Sunčev sustav)



jezgara...npr. kisik

		14F P	15F 1.0 MeV P: 100.00%	16F 40 KeV P: 100.00%	17F 64.49 S ε: 100.00%	18F 1.8291 H ε: 100.00%	19F STABLE 100%	20F 11.07 S β-: 100.00%	
	12O 0.40 MeV P	13O 8.58 MS ε: 100.00%	14O 70.606 S ε: 100.00%	15O 122.24 S ε: 100.00%	16O STABLE 99.762%	17O STABLE 0.038%	18O STABLE 0.200%	19O 26.88 S β-: 100.00%	
10N P: 100.00%	11N 1.58 MeV P: 100.00%	12N 11.000 MS ε: 100.00%	13N 9.965 M ε: 100.00%	14N STABLE 99.634%	15N STABLE 0.366%	16N 7.13 S β-: 100.00% β-α: 1.2E-3%	17N 4.173 S β-: 100.00% β-n: 95.1%	18N 624 MS β-: 100.00% β-n: 14.30%	
9C 126.5 MS ε: 100.00% εp: 61.60%	10C 19.290 S ε: 100.00%	11C 20.334 M ε: 100.00%	12C STABLE 98.89%	13C STABLE 1.11%	14C 5700 Y β-: 100.00%	15C 2.449 S β-: 100.00%	16C 0.747 S β-: 100.00% β-n: 99.00%	17C 193 MS β-: 100.00% β-n: 32.00%	
8B 770 MS εα: 100.00% ε: 100.00%	9B 0.54 KeV 2α: 100.00% P: 100.00%	10B STABLE 19.8%	11B STABLE 80.2%	12B 20.20 MS β-: 100.00% B3A: 1.58%	13B 17.33 MS β-: 100.00%	14B 12.5 MS β-: 100.00% β-n: 6.04%	15B 9.93 MS β-: 100.00% β-n: 93.60%	16B <190 PS N	

16 VIA 17 VIIA

8 15.999	9 18.998
N DUŠIK	O KISIK
15 30.974	16 32.065
	F FLUOR

Ponedjeljak, 21.3.2016. - Milivoj U
Radionica IRB

Element tehnecij nema stabilnih izotopa...

96Pd 122 S ε: 100.00%	97Pd 3.10 M ε: 100.00%	98Pd 17.7 M ε: 100.00%	99Pd 21.4 M ε: 100.00%	100Pd 3.63 D ε: 100.00%	101Pd 8.47 H ε: 100.00%	102Pd STABLE 1.02%	103Pd 16.991 D ε: 100.00%	104Pd STABLE 11.14%	105Pd STABLE 22.33%	106Pd STABLE 27.33%
95Rh 5.02 M ε: 100.00%	96Rh 9.90 M ε: 100.00%	97Rh 30.7 M ε: 100.00%	98Rh 8.72 M ε: 100.00%	99Rh 16.1 D ε: 100.00%	100Rh 20.8 H ε: 100.00%	101Rh 3.3 Y ε: 100.00%	102Rh 207 D ε: 78.00% β-: 22.00%	103Rh STABLE 100%	104Rh 42.3 S β-: 99.55% ε: 0.45%	105Rh 35.36 H β-: 100.00%
94Ru 51.8 M ε: 100.00%	95Ru 1.643 H ε: 100.00%	96Ru STABLE 5.54%	97Ru 2.791 D ε: 100.00%	98Ru STABLE 1.87%	99Ru STABLE 12.76%	100Ru STABLE 12.60%	101Ru STABLE 17.06%	102Ru STABLE 31.55%	103Ru 39.26 D β-: 100.00%	104Ru STABLE 18.62%
93Tc 2.75 H ε: 100.00%	94Tc 293 M ε: 100.00%	95Tc 20.0 H ε: 100.00%	96Tc 4.28 D ε: 100.00%	97Tc 4.21E+6 Y ε: 100.00%	98Tc 4.2E+6 Y β-: 100.00%	99Tc 2.111E+5 Y β-: 100.00%	100Tc 15.46 S β-: 100.00% ε: 1.8E-3%	101Tc 14.22 M β-: 100.00%	102Tc 5.28 S β-: 100.00%	103Tc 54.2 S β-: 100.00%
92Mo STABLE 14.84%	93Mo 4.0E+3 Y ε: 100.00%	94Mo STABLE 9.25%	95Mo STABLE 15.92%	96Mo STABLE 16.68%	97Mo STABLE 9.55%	98Mo STABLE 24.13%	99Mo 2.7489 D β-: 100.00%	100Mo 7.3E+18 Y 9.63% 2β-: 100.00%	101Mo 14.61 M β-: 100.00%	102Mo 11.3 M β-: 100.00%
91Nb 6.8E+2 Y ε: 100.00%	92Nb 3.47E+7 Y ε: 100.00% β- < 0.05%	93Nb STABLE 100%	94Nb 2.03E+4 Y β-: 100.00%	95Nb 34.991 D β-: 100.00%	96Nb 23.35 H β-: 100.00%	97Nb 72.1 M β-: 100.00%	98Nb 2.86 S β-: 100.00%	99Nb 15.0 S β-: 100.00%	100Nb 1.5 S β-: 100.00%	101Nb 7.1 S β-: 100.00%

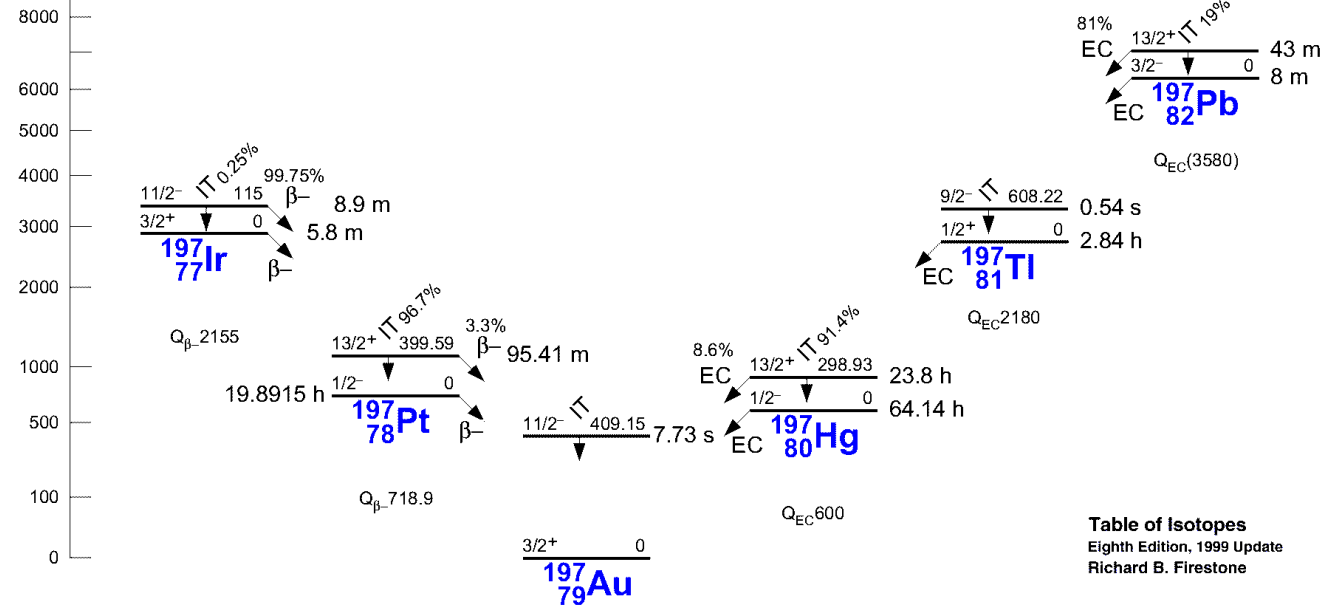
Zlato ima jedan stabilan izotop...

196Pb 37 M $\epsilon: 100.00\%$ $\alpha: 3.0E-5\%$	197Pb 8.1 M $\epsilon: 100.00\%$	198Pb 2.4 H $\epsilon: 100.00\%$	199Pb 90 M $\epsilon: 100.00\%$	200Pb 21.5 H $\epsilon: 100.00\%$	201Pb 9.33 H $\epsilon: 100.00\%$	202Pb 52.5E+3 Y $\epsilon: 100.00\%$ $\alpha: < 1.00\%$	203Pb 51.92 H $\epsilon: 100.00\%$	204Pb $\geq 1.4E+17$ Y 1.4% α	205Pb 1.73E+7 Y $\epsilon: 100.00\%$	206Pb STABLE 24.1%
195Tl 1.16 H $\epsilon: 100.00\%$	196Tl 1.84 H $\epsilon: 100.00\%$	197Tl 2.84 H $\epsilon: 100.00\%$	198Tl 5.3 H $\epsilon: 100.00\%$	199Tl 7.42 H $\epsilon: 100.00\%$	200Tl 26.1 H $\epsilon: 100.00\%$	201Tl 3.0421 D $\epsilon: 100.00\%$	202Tl 12.23 D $\epsilon: 100.00\%$	203Tl STABLE 29.524%	204Tl 3.78 Y $\beta^-: 97.10\%$ $\epsilon: 2.90\%$	205Tl STABLE 70.476%
194Hg 444 Y $\epsilon: 100.00\%$	195Hg 10.53 H $\epsilon: 100.00\%$	196Hg STABLE 0.15%	197Hg 64.14 H $\epsilon: 100.00\%$	198Hg STABLE 9.97%	199Hg STABLE 16.87%	200Hg STABLE 23.10%	201Hg STABLE 13.18%	202Hg STABLE 29.86%	203Hg 46.594 D $\beta^-: 100.00\%$	204Hg STABLE 6.87%
193Au 17.65 H $\epsilon: 100.00\%$	194Au 38.02 H $\epsilon: 100.00\%$	195Au 186.098 D $\epsilon: 100.00\%$	196Au 6.1669 D $\epsilon: 93.00\%$ $\beta^-: 7.00\%$	197Au STABLE 100%	198Au 2.6956 D $\beta^-: 100.00\%$	199Au 3.139 D $\beta^-: 100.00\%$	200Au 48.4 M $\beta^-: 100.00\%$	201Au 26.0 M $\beta^-: 100.00\%$	202Au 28.8 S $\beta^-: 100.00\%$	203Au 60 S $\beta^-: 100.00\%$
192Pt STABLE 0.782%	193Pt 50 Y $\epsilon: 100.00\%$	194Pt STABLE 32.967%	195Pt STABLE 33.832%	196Pt STABLE 25.242%	197Pt 19.8915 H $\beta^-: 100.00\%$	198Pt STABLE 7.163%	199Pt 30.80 M $\beta^-: 100.00\%$	200Pt 12.6 H $\beta^-: 100.00\%$	201Pt 2.5 M $\beta^-: 100.00\%$	202Pt 44 H $\beta^-: 100.00\%$
191Ir STABLE 37.3%	192Ir 73.827 D $\beta^-: 95.13\%$ $\epsilon: 4.87\%$	193Ir STABLE 62.7%	194Ir 19.28 H $\beta^-: 100.00\%$	195Ir 2.5 H $\beta^-: 100.00\%$	196Ir 52 S $\beta^-: 100.00\%$	197Ir 5.8 M $\beta^-: 100.00\%$	198Ir 8 S $\beta^-: 100.00\%$	199Ir β^-		

Zlato in

¹⁹⁶Pb 37 M	¹⁹⁷Pb 8.1 M	¹⁹⁸Pb 2.4 H
$\epsilon \approx 100.00\%$ $\alpha \leq 3.0E-5\%$	$\epsilon: 100.00\%$	$\epsilon: 100.00\%$
¹⁹⁵Tl 1.16 H	¹⁹⁶Tl 1.84 H	¹⁹⁷Tl 2.84 H
$\epsilon: 100.00\%$	$\epsilon: 100.00\%$	$\epsilon: 100.00\%$

¹⁹⁴Hg 444 Y	¹⁹⁵Hg 10.53 H	¹⁹⁶Hg STABLE 0.15%	¹⁹⁷Hg 64.14 H	¹⁹⁸Hg STABLE 9.97%	¹⁹⁹Hg STABLE 16.87%	²⁰⁰Hg STABLE 23.10%	²⁰¹Hg STABLE 13.18%	²⁰²Hg STABLE 29.86%	²⁰³Hg 46.594 D	²⁰⁴Hg STABLE 6.87%
$\epsilon: 100.00\%$	$\epsilon: 100.00\%$		$\epsilon: 100.00\%$						$\beta^-: 100.00\%$	
¹⁹³Au 17.65 H	¹⁹⁴Au 38.02 H	¹⁹⁵Au 186.098 D	¹⁹⁶Au 6.1669 D	¹⁹⁷Au STABLE 100%	¹⁹⁸Au 2.6956 D	¹⁹⁹Au 3.139 D	²⁰⁰Au 48.4 M	²⁰¹Au 26.0 M	²⁰²Au 28.8 S	²⁰³Au 60 S
$\epsilon: 100.00\%$	$\epsilon: 100.00\%$	$\epsilon: 100.00\%$	$\epsilon: 93.00\%$ $\beta^-: 7.00\%$		$\beta^-: 100.00\%$	$\beta^-: 100.00\%$	$\beta^-: 100.00\%$	$\beta^-: 100.00\%$	$\beta^-: 100.00\%$	$\beta^-: 100.00\%$
¹⁹²Pt STABLE 0.782%	¹⁹³Pt 50 Y	¹⁹⁴Pt STABLE 32.967%	¹⁹⁵Pt STABLE 33.832%	¹⁹⁶Pt STABLE 25.242%	¹⁹⁷Pt 19.8915 H	¹⁹⁸Pt STABLE 7.163%	¹⁹⁹Pt 30.80 M	²⁰⁰Pt 12.6 H	²⁰¹Pt 2.5 M	²⁰²Pt 44 H
	$\epsilon: 100.00\%$				$\beta^-: 100.00\%$		$\beta^-: 100.00\%$	$\beta^-: 100.00\%$	$\beta^-: 100.00\%$	$\beta^-: 100.00\%$
¹⁹¹Ir STABLE 37.3%	¹⁹²Ir 73.827 D	¹⁹³Ir STABLE 62.7%	¹⁹⁴Ir 19.28 H	¹⁹⁵Ir 2.5 H	¹⁹⁶Ir 52 S	¹⁹⁷Ir 5.8 M	¹⁹⁸Ir 8 S	¹⁹⁹Ir		
	$\beta^-: 95.13\%$ $\epsilon: 4.87\%$		$\beta^-: 100.00\%$	$\beta^-: 100.00\%$	$\beta^-: 100.00\%$	$\beta^-: 100.00\%$	$\beta^-: 100.00\%$	β^-		



Uran nema stabilnih izotopa...

233Pu 20.9 M ϵ : 99.88% α : 0.12%	234Pu 8.8 H ϵ : 94.00% α : 6.00%	235Pu 25.3 M ϵ : 100.00% α : 2.8E-3%	236Pu 2.858 Y α : 100.00% SF: 1.9E-7%	237Pu 45.2 D ϵ : 100.00% α : 4.2E-3%	238Pu 87.7 Y α : 100.00% SF: 1.9E-7%	239Pu 24110 Y α : 100.00% SF: 3.E-10%	240Pu 6561 Y α : 100.00% SF: 5.7E-6%	241Pu 14.290 Y β^- : 100.00% α : 2.5E-3%	242Pu 3.75E+5 Y α : 100.00% SF: 5.5E-4%
232Np 14.7 M ϵ : 100.00% α : 2.0E-4%	233Np 36.2 M ϵ : 100.00% α : 1.0E-3%	234Np 4.4 D ϵ : 100.00%	235Np 396.1 D ϵ : 100.00% α : 2.6E-3%	236Np 153E+3 Y ϵ : 86.30% β^- : 13.50%	237Np 2.144E+6 Y α : 100.00% SF: 2E-10%	238Np 2.117 D β^- : 100.00%	239Np 2.356 D β^- : 100.00%	240Np 61.9 M β^- : 100.00%	241Np 13.9 M β^- : 100.00%
231U 4.2 D ϵ : 100.00% α : 4.0E-3%	232U 68.9 Y α : 100.00% SF: 9E-20%	233U 1.592E+5 Y α : 100.00% SF: 6.0E-9%	234U 2.455E+5 Y 0.0054% α : 100.00% SF: 1.6E-9%	235U 7.04E+8 Y 0.7204% α : 100.00% SF: 7.0E-9%	236U 2.342E7 Y α : 100.00% SF: 9.4E-8%	237U 6.75 D β^- : 100.00%	238U 4.468E9 Y 99.2742% α : 100.00% SF: 5.5E-5%	239U 23.45 M β^- : 100.00%	240U 14.1 H β^- : 100.00%
230Pa 17.4 D ϵ : 92.20% β^- : 7.80%	231Pa 3.276E+4 Y α : 100.00% SF: 3E-10%	232Pa 1.32 D β^- : 100.00% ϵ : 3.0E-3%	233Pa 26.975 D β^- : 100.00%	234Pa 6.70 H β^- : 100.00%	235Pa 24.44 M β^- : 100.00%	236Pa 9.1 M β^- : 100.00%	237Pa 8.7 M β^- : 100.00%	238Pa 2.27 M β^- : 100.00% SF: 2.6E-6%	239Pa 1.8 H β^- : 100.00%
229Th 7340 Y α : 100.00%	230Th 7.54E+4 Y α : 100.00% 24Ne: 6E-11%	231Th 25.52 H β^- : 100.00% α : 4E-11%	232Th 1.40E10 Y 100% α : 100.00% SF: 1.1E-9%	233Th 21.83 M β^- : 100.00%	234Th 24.10 D β^- : 100.00%	235Th 7.2 M β^- : 100.00%	236Th 37.3 M β^- : 100.00%	237Th 4.7 M β^- : 100.00%	238Th 9.4 M β^- : 100.00%

...ali ima dva izotopa koji žive toliko dugo da su tu OD NASTANKA ZEMLJE!

- U prirodi nalazimo SVE stabilne izotope, pa znamo da su nastali i radioaktivni, ali su se u međuvremenu uglavnom raspali u stabilne
- Ostaci radioaktivnog raspada nam daju uvid u trenutak nastanka ili grupiranja atoma u nekom uzorku
- Tek je nuklearna fizika dala metode određivanja starosti Zemlje i geoloških epoha

Matematički kutak:

$$N(t) = N_0 \cdot 2^{-\frac{t}{T}}$$

$$A(t) = -\frac{dN}{dt} = N_0 \cdot 2^{-\frac{t}{T}} \cdot \frac{\ln(2)}{T}$$

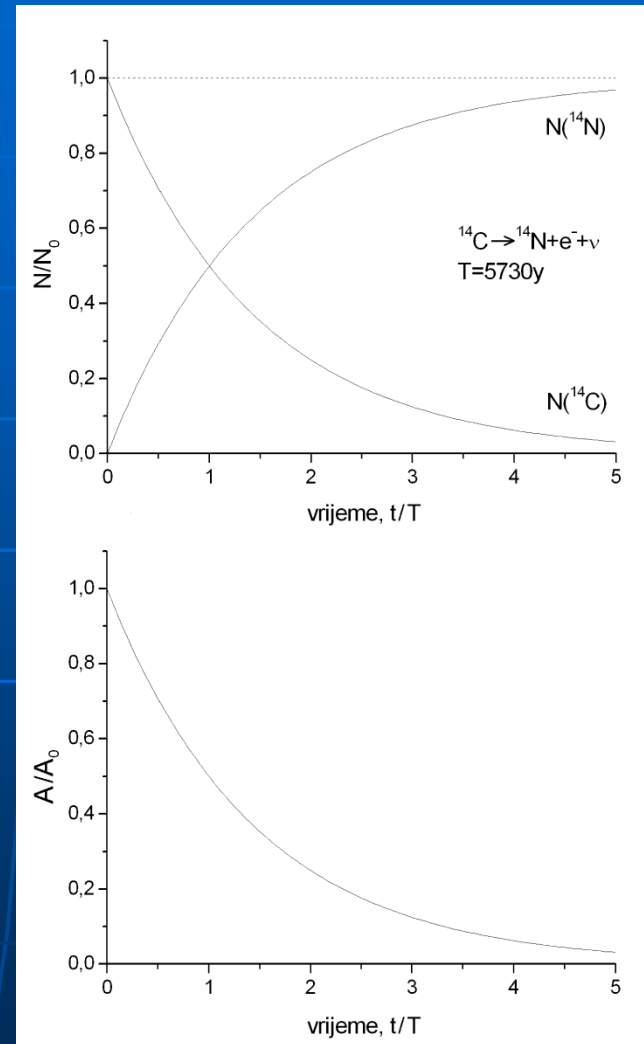
$$A = \frac{N \cdot \ln(2)}{T}$$

$$N = \frac{m}{M} \cdot N_A$$

T – vrijeme poluraspada

N – broj atoma

A – aktivnost, broj raspada u sekundi



Krive predodžbe o radioaktivnosti

- Radioaktivnost je isključivo produkt ljudske djelatnosti
- Radioaktivnost postoji u prirodnom materijalu. Većina kratkoživućih izotopa nije u prirodi prisutna zato što su se (davno) raspali

Krive predodžbe o radioaktivnosti

- Radioaktivni se atomi raspadaju na sastavne dijelove
- Raspadi atoma se odvijaju prema stanju niže energije, što uglavnom rezultira stabilnim atomom drugog kem. elementa istog masenog broja

Krive predodžbe o radioaktivnosti

- Radioaktivni npr. ugljik se kemijski ponaša drukčije od “normalnog” ugljika
- Izotopi nekog elementa kemijski se ponašaju jednako, bez obzira jesu li stabilni ili radioaktivni. Radioizotop se lakše detektira, upravo zbog svog raspada.

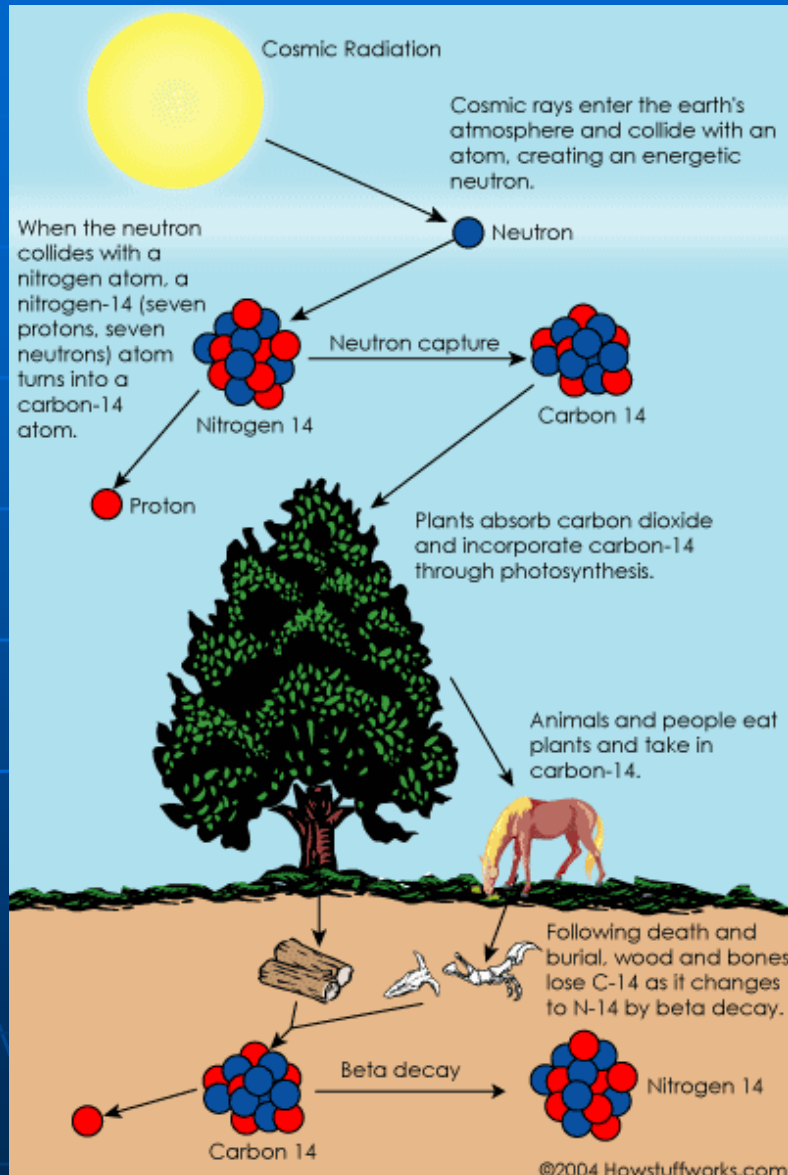
Krive predodžbe o radioaktivnosti

- Mjerenje dugog vremena poluraspada ne može biti precizno ako za radioaktivnost znamo tek stotinjak godina
- Mjerenjem aktivnosti i mase, vrijeme poluraspada se svodi na poznavanje Avogadrove konstante. Omjer broja raspada i ukupnog broja atoma može biti toliko velik da u sekundi određuje vrlo duga vremena poluraspada

Krive predodžbe o radioaktivnosti

- Kad prođe dovoljno vremena, u radioaktivnom uzorku su drukčiji atomi
- Raspadom radioizotopa nastaju jezgre-kćerke, a neraspadnuti atomi su identični onima na početku tj. nisu "ostarili"

Datiranje pomoću ^{14}C ($T=5730$ godina)



Stabilni izotopi kisika u fotosintezi

■ Fotosinteza:



U ranim fazama istraživanja postavilo se pitanje potječe li nastali kisik iz vode ili ugljik dioksida?

H_2^{18}O stvara kisik bogat izotopom ^{18}O

C^{18}O_2 stvara "običan" kisik

Slijedi da kisik dolazi iz vode, što daje uvid u redoslijed